Revised 5/5/2021

RISSO'S DOLPHIN (*Grampus griseus*): Hawaii Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Risso's dolphins are found in tropical to warm-temperate waters worldwide (Perrin *et al*. 2009). Risso's dolphins represent less than 1% of all odontocete sightings in leeward surveys of the main Hawaii Islands from 2000 to 2012 (Baird *et al*. 2013); however, six sightings were made during a 2002 survey, 12 during a 2010 survey, and 12 during a 2017 survey of the U.S. Exclusive Economic Zone (EEZ) of the Hawaiian Islands (Barlow 2006, Bradford *et al*. 2017, Yano *et al*. 2018; Figure 1). Most sightings of Risso's dolphins occur in deep waters offshore. A single satellite tagged animal moved broadly between offshore waters off Kona, Kohoolawe, and Lanai over a 2 week period (Baird 2016). Sighting, habitat, and limited movement data do not appear to support finer population structure in Hawaiian waters.

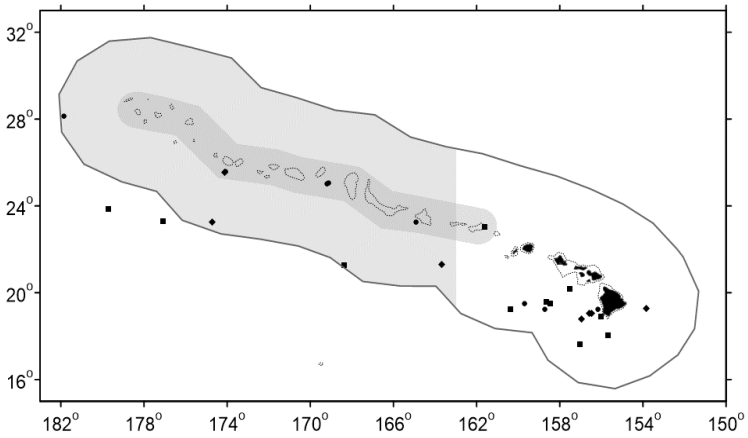

Figure 1. Risso's dolphin sighting locations during the 2002 (diamonds), 2010 (circle), and 2017 (square) shipboard cetacean surveys of U.S. EEZ waters surrounding the Hawaiian Islands (Barlow 2006, Bradford *et al*. 2017, Yano *et al*. 2018). Outer line represents approximate boundary of survey area and U.S. EEZ. Dark and light gray shading indicate the original and 2016 Expanded area of Papahanaumokuakea Marine National Monument. Dotted line is the 1000 m isobath.

For the Marine Mammal Protection Act (MMPA) stock assessment reports, Risso's dolphins within the Pacific U.S. EEZ are divided into two discrete, non-contiguous areas: 1) Hawaiian waters (this report), and 2) waters off California, Oregon and Washington. The Hawaiian stock includes animals found both within the Hawaiian Islands EEZ and in adjacent high seas waters; however, because data on abundance, distribution, and human-caused impacts are largely lacking for high seas waters, the status of this stock is evaluated based on data from U.S. EEZ waters of the Hawaiian Islands (NMFS 2005).

POPULATION SIZE

Encounter data from shipboard line-transect surveys of the entire Hawaiian Islands EEZ was recently reevaluated, resulting in the updated model-based abundance estimates of Risso's dolphins in the Hawaii EEZ (Becker *et al*. 2021; Table 1).

Table 1. Line-transect abundance estimates for Risso's dolphins derived from surveys of the entire Hawaii EEZ in 2002, 2010, and 2017 (Becker *et al*. 2021).

Year	Model-based abundance	CV	95% Confidence Limits
2017	7,385	0.22	4,817-11,322
2010	6,174	0.20	4,159-9,165
2002	6,916	0.21	4,623-10,346

Sighting data from 2002 to 2017 within the Hawaii EEZ were used to derive habitat-based models of animal density for the overall period. The models were then used to predict density and abundance for each survey year based on the environmental conditions within that year (see Forney *et al*. 2015, Becker *et al*. 2016). The modeling framework incorporated Beaufort-specific trackline detection probabilities for Risso's dolphins from Barlow *et al*. (2015).

Bradford *et al*. (2021) produced design-based abundance estimates for Risso's dolphins for each survey year that can be used as a point of comparison to the model-based estimates. While on average the estimates are broadly similar between the two approaches, the annual design-based estimates show much greater variability between years than do the model-based estimates (Figure 2). The model-based approach reduces variability through explicit examination of habitat relationships across the full dataset, while the design-based approach evaluates encounter data for each year separately and thus is more susceptible to the effects of encounter rate variation. Model-based estimates include the implicit assumption that changes in abundance are attributed to environmental variability alone. There are insufficient data to explicitly incorporate a trend term into the model due to the insufficient sample size to test for temporal effects. Despite not fully accounting for inter-annual variation in total abundance, the model-based estimates are considered the best available estimate for each survey year. Previously published design-based estimates for the Hawaii EEZ from 2002 and 2010 surveys (e.g. Barlow 2006, Bradford *et al*. 2017) used a subset of the dataset used by Becker *et al*. (2021) and Bradford *et al*. (2021) to derive line-transect parameters, such that these estimates have been superseded by the estimates presented here. The best estimate of abundance is based on the 2017 survey, or 7,385 (CV=0.22). Population estimates have been made off Japan (Miyashita 1993), in the eastern tropical Pacific (Wade and Gerrodette 1993), and off the U.S. West Coast (Barlow 2016), but it is not known whether these animals are part of the same population that occurs around the Hawaiian Islands and in the central North Pacific.

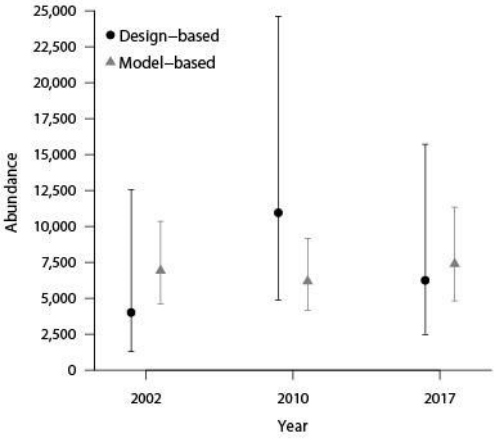

Figure 2. Comparison of design-based (circles, Bradford *et al*. 2021) and model-based (triangles, Becker *et al*. 2021) estimates of abundance for Risso's dolphins for each survey year (2002, 2010, 2017).

Minimum Population Estimate

The minimum population size is calculated as the lower 20th percentile of the log-normal distribution (Barlow *et al*. 1995) of the 2017 abundance estimate, or 6,150 Risso's dolphins within the Hawaiian Islands EEZ.

Current Population Trend

The model-based abundance estimates for Risso's dolphins provided by Becker *et al.* (2021) do not explicitly allow for examination of population trend other than that driven by environmental factors. Model-based examination of Risso's dolphin trends including sighting data beyond the Hawaii EEZ will be required to more fully examine trend for this stock.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No data are available on current or maximum net productivity rate for Hawaiian animals.

POTENTIAL BIOLOGICAL REMOVAL

The potential biological removal (PBR) level for the Hawaii stock of Risso's dolphins is calculated as the minimum population size within the U.S. EEZ of the Hawaiian Islands (6,150) times one half the default maximum net growth rate for cetaceans (½ of 4%) times a recovery factor of 0.5 (for a stock of unknown status with no known fishery mortality and serious injury within the Hawaii EEZ; Wade and Angliss 1997), resulting in a PBR of 61 Risso's dolphins per year.

HUMAN CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Information on fishery-related mortality and serious injury of cetaceans in Hawaiian waters is limited, but the gear types used in Hawaiian fisheries are responsible for marine mammal mortality and serious injury in other fisheries throughout U.S. waters. No interactions between nearshore fisheries and Risso's dolphins have been reported

in Hawaiian waters. No estimates of human-caused mortality or serious injury are currently available for nearshore hook and line fisheries because these fisheries are not observed or monitored for protected species bycatch.

There are currently two distinct longline fisheries based in Hawaii: a deep-set longline (DSLL) fishery that targets primarily tunas, and a shallow-set longline fishery (SSLL) that targets swordfish. Both fisheries operate within U.S. waters and on the high seas. Between 2014 and 2018, 15 Risso's dolphins were observed killed or seriously injured in the SSLL fishery (100% observer coverage), and the injury status of one could not be determined based on the observer's description, and 3 Risso's dolphins were observed killed or seriously injured in the DSLL fishery (18-21% observer coverage) (Figure 3, Bradford 2018a, 2018b, 2020, Bradford and Forney 2017, McCracken 2019). One Risso's dolphin in the DSLL fishery and four in the SSLL fishery were killed, 10 in the SSLL fishery and 2 in the DSLL fishery were considered to have been seriously injured, and the remaining interactions in the SSLL fishery could not be determined based on an evaluation of the observer's description of the interaction. When otherwise undetermined, the injury status of takes is prorated to serious versus non-serious using the historic rate of serious injury within the observed takes. Average 5-yr estimates of annual mortality and serious injury for 2014-2018 are 5.7 (CV = 0.7) Risso's dolphins outside of U.S. EEZs, and 0 within the Hawaiian Islands EEZ (Table 2, McCracken 2019). One additional unidentified cetacean, possibly a Risso's dolphin based on the observer's description, and three other unidentified delphinids were taken in the DSLL fishery, some of which may have been Risso's dolphins.

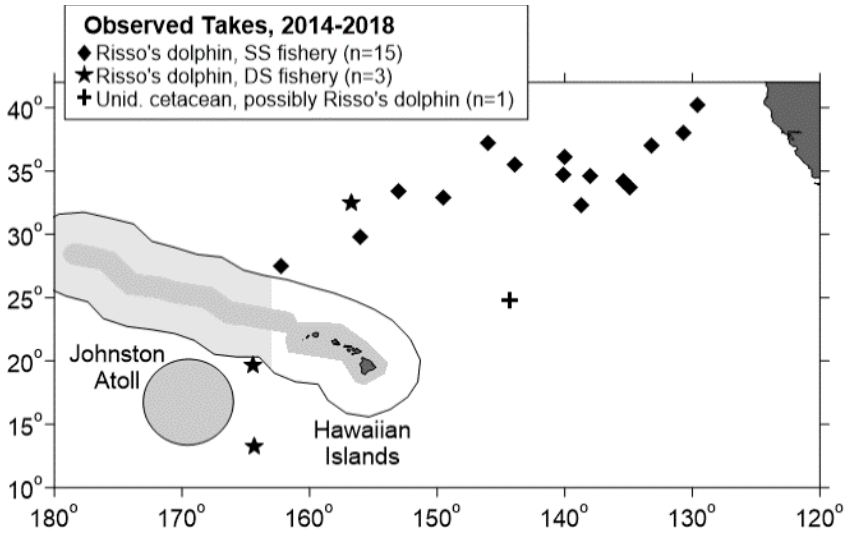

Figure 3. Locations of Risso's dolphin takes and unidentified cetaceans that may be Risso's dolphins based on the observer's description in Hawaii-based longline fisheries, 2014-2018. Solid lines represent the U.S. EEZs. Gray shading notes areas closed to commercial fishing, with the PMNM Expansion area closed since August 2016.

STATUS OF STOCK

The Hawaii stock of Risso's dolphins is not considered strategic under the 1994 amendments to the MMPA. The status of Risso's dolphins in Hawaiian waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. Risso's dolphins are not listed as "threatened" or "endangered" under the Endangered Species Act (1973), nor designated as "depleted" under the MMPA. Given the absence of recent recorded fishery-related mortality or serious injuries within the U.S. EEZ, the total fishery mortality and serious injury can be considered to be insignificant and approaching zero. One Risso's dolphin stranded on the MHI tested positive for *Morbillivirus* (Jacob *et al*. 2016). The presence of *morbillivirus* in 10 species of cetacean in Hawaiian waters, all identified as a unique strain of *morbillivirus*, (Jacob *et al*. 2016), raises concerns about the history and prevalence of this disease in Hawaii and the potential population impacts, including cumulative impacts of disease with other stressors.

Table 2. Summary of available information on incidental mortality and serious injury of Risso's dolphin (Hawaii stock) in commercial longline fisheries, within and outside of U.S. EEZs (McCracken 2019). Mean annual takes are based on 2014-2018 data unless indicated otherwise. Information on all observed takes (T) and combined mortality events & serious injuries (MSI) is included. Total takes were prorated to deaths, serious injuries, and non-serious injuries based on the observed proportions of each outcome.

Fishery Name	Year	Data Type	Percent Observer Coverage	Observed total interactions (T) and mortality events, and serious injuries (MSI), and total estimated mortality and serious injury (M&SI) of Risso's dolphins			
				Outside U.S. EEZs		Hawaiian EEZ	
				Obs. T/MSI	Estimated M&SI (CV)	Obs. T/MSI	Estimated M&SI (CV)
Hawaii-based deep-set longline fishery	2014	Observer data	21%	0	0 (-)	0	0 (-)
	2015		21%	2/2	10 (0.6)	0	0 (-)
	2016		20%	0	0 (-)	0	0 (-)
	2017		20%	1/1	5 (0.9)	0	0 (-)
	2018		18%	0	0 (-)	0	0 (-)
Mean Estimated Annual Take (CV)					**2.9 (0.7)**		**0 (-)**
Hawaii-based shallow-set longline fishery	2014	Observer data	100%	6/6†	6	0	0
	2015		100%	3/3	3	0	0
	2016		100%	2/2	2	0	0
	2017		100%	2/2	2	0	0
	2018		100%	2/2	2	0	0
Mean Annual Takes (100% coverage)					**2.8**		**0**
Minimum total annual takes within U.S. EEZ							**0 (-)**

† Injury status could not be determined based on information collected by the observer. Injury status is prorated (see text).

REFERENCES

Baird, R.W., D.L. Webster, J.M. Aschettino, G.S. Schorr, and D.J. McSweeney. 2013. Odontocete cetaceans around the main Hawaiian Islands: Habitat use and relative abundance from small-boat sighting surveys. Aquatic Mammals 39:253-269.

Baird, R.W. 2016. The lives of Hawaii's whales and dolphins: natural history and conservation. University of Hawaii Press. 341 p.

Barlow, J. 2006. Cetacean abundance in Hawaiian waters estimated from a summer/fall survey in 2002. Marine Mammal Science 22(2): 446-464.

Barlow, J. 2016. Cetacean abundance in the California current estimated from ship-based line-transect surveys in 1991-2014. Southwest Fisheries Science Center, Administrative Report, LJ-2016-01. 63 p.

Barlow, J. 2015. Inferring trackline detection probabilities, g(0), for cetaceans from apparent densities in different survey conditions. Mar. Mamm. Sci. 31:923–943.

Barlow, J., S.L. Swartz, T.C. Eagle, and P.R. Wade. 1995. U.S. Marine Mammal Stock Assessments: Guidelines for Preparation, Background, and a Summary of the 1995 Assessments. U.S. Dept. of Commerce, NOAA Technical Memorandum NMFS-OPR-6, 73 p.

Becker, E.A., K.A. Forney, P.A. Fiedler, J. Barlow, S.J. Chivers, C.A. Edwards, A.M. Moore, J.V. Redfern. 2016. Moving towards dynamic ocean management: How well do modeled ocean products predict species distributions? Remote Sensing, 8, 149.

Becker, E.A., K.A. Forney, E.M. Oleson, A.L. Bradford, J.E. Moore, J. Barlow. 2021. Habitat-based density models for cetaceans within the U.S Exclusive Economic Zone waters around the Hawaiian Archipelago. NOAA-TM-NMFS-PIFSC-116.

Bradford, A.L. 2018a. Injury Determinations for Marine Mammals Observed Interacting with Hawaii and American Samoa Longline Fisheries During 2015-16. U.S. Dept. of Commerce, NOAA Technical Memorandum NMFS-PIFSC-70, 27p. https:/doi.org/10.7289/V5/TM-PIFSC-70.

Bradford A.L. 2018b. Injury Determinations for Marine Mammals Observed Interacting with Hawaii and American Samoa Longline Fisheries During 2017. U.S. Dept. of Commerce, NOAA Technical Memorandum NMFS-

PIFSC -76, 14 p. doi:10.25923/fzad-4784.
Bradford, A.L. 2020. Injury Determinations for Marine Mammals Observed Interacting with Hawaii and American Samoa Longline Fisheries During 2018. NOAA-TM-NMFS-PIFSC-99.
Bradford, A.L. and K.A. Forney. 2017. Injury determinations for cetaceans observed interacting with Hawaii and American Samoa longline fisheries during 2010-2014. NOAA-TM-NMFS-PIFSC-62, doi:10.7289/V5/TM-PIFSC-62
Bradford, A.L., K.A. Forney, E.M. Oleson, and J. Barlow. 2017. Abundance estimates of cetaceans from a line-transect survey within the U.S Hawaiian Islands Exclusive Economic Zone. Fishery Bulletin 115:129-142.
Bradford, A.L., E.M. Oleson, K.A. Forney, J.E. Moore, and J. Barlow. 2021. Line-transect abundance estimates of cetaceans in U.S. waters around the Hawaiian Islands in 2002, 2010, and 2017. NOAA-TM-NMFS-PIC-115.
Forney, K.A., E.A Becker, D.G. Foley, J. Barlow, and E.M. Oleson. 2015. Habitat-based models of cetacean density and distribution in the central North Pacific. Endangered Species Research 27:1–20.
Jacob, J.M., K.L. West, G. Levine, S. Sanchez, and B.A. Jensen. 2016. Initial characterization of novel beaked whale morbillivirus in Hawaiian cetaceans. Disease of Aquatic Organisms 117:215-227. doi:10.3354/dao02941.
McCracken, M.L. 2019. Assessment of incidental interactions with marine mammals in the Hawaii longline deep and shallow-set fisheries from 2014 through 2018. PIFSC Data Report DR-19-031. https:/doi.org/10.25923/0frt-ms58.
Miyashita, T. 1993. Abundance of dolphin stocks in the western North Pacific taken by the Japanese drive fishery. Rep. Int. Whal. Commn. 43:417-437.
Nitta, E. and J.R. Henderson. 1993. A review of interactions between Hawaii's fisheries and protected species. Mar. Fish. Rev. 55(2):83-92.
NMFS. 2005. Revisions to Guidelines for Assessing Marine Mammal Stocks. 24 pp.
NMFS. 2012. NOAA Fisheries Policy Directive 02-038-01 Process for Injury Determinations (01/27/12).
Perrin, W.F., B. Würsig, and J.G.M. Thewissen. 2009. Encyclopedia of Marine Mammals. Second Edition. Academic Press, Amsterdam.
Wade, P.R. and R.P. Angliss. 1997. Guidelines for Assessing Marine Mammal Stocks: Report of the GAMMS Workshop April 3-5, 1996, Seattle, Washington. U.S. Dept. of Commerce, NOAA Technical Memorandum NMFS-OPR-12. 93 pp.
Wade, P.R. and T. Gerrodette. 1993. Estimates of cetacean abundance and distribution in the eastern tropical Pacific. Rep. Int. Whal. Commn. 43:477-493.
Yano K.M., E.M. Oleson, J.L Keating, L.T. Balance, M.C. Hill, A.L. Bradford, A.N. Allen, T.W. Joyce, J.E. Moore, and A. Henry. 2018. Cetacean and seabird data collected during the Hawaiian Islands Cetacean and Ecosystem Assessment Survey (HICEAS), July-December 2017. U.S. Dept. of Commerce, NOAA Technical Memorandum NOAA-TM-NMFS-PIFSC-72, 110 p.